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STUDIES ON LIFE HISTORY OF *HEMIPYRELLIA LIGURRIENS* (WIEDEMANN) (DIPTERA : CALLIPHORIDAE) IN SUNDARBANS BIOSPHERE RESERVE, WEST BENGAL, INDIA

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INTRODUCTION

This scavenger species are found abundantly in seashore, fishing port, dry fish processing centers, human faeces and market areas in Sundarbans Biosphere Reserve. They are very important in medical and veterinary sciences. The adults are suspected as the most potential vectors of different enteric pathogens. Roy and Dasgupta (1971) reported that the larvae of *Hemipyrellia ligurriens* could able to lead parasitic mode of live and they also showed that with experiment on live specimens the flies deposit eggs on the body and the larvae penetrate inside the body of earthworm, fish, toad, frog, wall lizard, pigeon and shrew. First, second and third instars larvae of this species have been described by Kano and Sato (1952) from Japan after rearing on raw fish in the laboratory conditions. Later on, Ishijima (1967) described only the third stage larvae from Japan and reported that the larvae breed in dead animals, garbage, human faeces and animal dung especially dog and cat dung. But nothing was reported regarding the life history and larval characters of this species from India. Abbreviations used in the adult figures are after Kano and Shinonaga (1968) and in the larval figures are after Ishijima (1967).

MATERIAL AND METHODS

A mating pair was collected from fish processing center at Ganga Sagar of Sundarbans Biosphere Reserve and brought to the laboratory in live condition. The male specimen was killed and identified as *Hemipyrellia ligurriens* (Wiedemann) and the live female fly was kept in a glass jar covering the mouth of the jar with silken cloth for rearing in the laboratory conditions. About 50 gm of raw coastal fish of *P. microdon* was supplied regularly to the female for deposition of eggs. After few days, the gravid female fly started for lying eggs on this raw fish. Later on, when the larvae

hatched out from eggs then some of them were taken out from the jar and placed in another glass jar (10 × 8 cm) providing 100 gm of above mentioned raw fish daily as their food. Here the mouth of the jar was also covered with double silken cloth so that the other flies cannot contaminate the culture medium. Moist sand was kept at the bottom of the glass jar to provide mature larvae a humid condition for pupation. The flies emerged out from this culture medium. After that a male and a female fly from this pure stock were taken out and kept in a jar of earlier size to study the different larval stages of this species in laboratory conditions of temperature $24 \pm 4^\circ\text{C}$ and at relative humidity of $66 \pm 4\%$. The mouth of the jar was also covered with double silken cloth. Sugar solution soaked in cotton was given above the silken cloth of the jar four times daily so that the adult flies get continuous food supply. For oviposition, 50 gm of above-mentioned raw fresh fish was supplied to the female regularly. Their mating was observed and the female fly deposited eggs on the fish after fifth day of mating. After hatching from eggs, four to five first stage larvae were taken out from the culture medium and collections of larvae were repeated every six hours up to the formation of pupae to study the exact duration of each instars. The collected larvae were killed by dropping them into slightly boiled water and preserved them in 70% alcohol for future study. To study the larval characters, they were boiled in 10% KOH solutions for 1–3 minutes and washed them in water to remove the excess KOH particles. To study the entire larvae, the internal debris was removed by making a puncture at one point and cleaned them with distilled water. The larvae were then dehydrated through alcoholic grades and finally to absolute alcohol. After proper dehydration, the larvae were cleaned with clove oil and mounted on slides with Canada balsam. For studying the anterior and posterior spiracles and cephalopharyngeal sclerite, these parts were dissected out with fine forceps putting them in cavity block and processed as earlier. The figures of different parts were drawn with the help of camera lucida before mounting them on slides with Canada balsam. For studying the male genitalia and female ovipositor, the posterior portion of the abdomen was dissected out with fine scissor. The dissected portions were boiled in a test tube immersed in 10% KOH solutions for 1–2 minutes. Then the genitalia portion and ovipositor were placed in separate cavity block and different parts of genitalia and ovipositor were dissected under stereoscopic binocular microscope with fine needles and later on washed the dissected parts with distilled water to remove excess KOH. They were then transferred to 30% alcohol and different parts of genitalia and ovipositor were observed under same binocular microscope. After proper study the different parts of genitalia and ovipositor, they were processed through alcoholic grades for dehydration and finally to phenol and the figures of different parts were drawn with the help of camera lucida before mounting them on slides with Canada balsam.

OBSERVATION

The flies started mating from the fourth day of emergence up to seventh day. During mating, a male fly suddenly jumps over the female fly and grasps the female body with its prothoracic and

metathoracic legs. The duration of the mating was for 2–7 minutes. A female fly mated more than once with different males. On the twelfth day of emergence, the gravid female fly started to lay eggs. A total of 583 eggs were laid in seven batches and completed on thirty ninth day of emergence with highest number on twenty fourth day. Total numbers of eggs deposited by a female fly in laboratory conditions are shown in chart 1. Among the total eggs deposited by a female fly, 86% of the eggs hatched out and 61% of the larvae were survived up to pupation. Longevity of the male and female flies with food and without food was noted. Average longevity of male and female was about 33 to 51 days respectively. Females survived more than males feeding on dilute sugar solution. The flies could survive 4–5 days without food after emergence. Sex ratio of male and female was 1 : 1.

Chart 1. : Number of eggs deposited by a female fly.

Batches	Days of emergence	Number of eggs
1 st batch	12 th	71
2 nd batch	16 th	91
3 rd batch	24 th	117
4 th batch	29 th	99
5 th batch	32 nd	74
6 th batch	34 th	67
7 th batch	39 th	64
		Total : 583

DESCRIPTION OF DIFFERENT STAGES

Immature Stages (Figs. 1-13)

Egg (Fig. 1) : White in colour. Its length varied from 1 to 1.2 mm and its diameter varied from 0.3 to 0.5 mm. It is almost oblong and posterior end is much wider than anterior end.

Eggs are hatched after 9 to 15 hours of oviposition.

Larvae : There are three larval instars. All have a clearly defined anterior cephalopharyngeal sclerite, three thoracic segments and eight abdominal segments.

First instar larva (Fig. 2) : White in colour. Its length varied from 2.5 to 3 mm and its diameter varied from 0.5 to 0.8 mm. Spine bands on segments weakly developed. Complete anterior spine bands present on segments 2 to 6. Spines present on dorsal surface of 6 segment. Posterior spine bands present on ventral surface of segments 5 to 10. Segment 11 with complete posterior band.

Cephalopharyngeal sclerite (Fig. 3) : Small, incompletely developed and not uniformly sclerotised. Oral hook part strong. Dorsal cornu deeply pigmented, long, pointed and slightly curved. Sinus wide and tubercles prominent.

Spiracles : No anterior spiracles. Posterior spiracles (Fig. 4) light brown with two slits. Spiracular slits not completely developed, which are attached ventrally and separated dorsally.

First instar larva is transformed into second instar larva after 5 to 6 hours of hatching.

Second instar larva (Fig. 5) : White in colour. Its length varied from 4 to 6 mm and its diameter varied from 0.9 to 1.1 mm. Anterior spine band on segment 6 is wide. Other spine bands are similar in position as in earlier instar. Dorsal tubercles reduced but ventral tubercles prominent.

Cephalopharyngeal sclerite (Fig. 6) : Uniformly pigmented. Anterior end of hook part more curved ventrally. Posterodorsal process projected upward. Parastomal sclerite long. Dorsal cornu pointed and long and it is structurally similar to first instar larva but with increased size. Ventral cornu shorter than the dorsal cornu which is with prominent window.

Spiracles : Anterior spiracles (Fig. 7) yellow, flower-like and each with 6–7 branches. Posterior spiracles (Fig. 8) deep brown, with two spiracular slits and the slits are separated completely.

Second instar larva is transformed into third instar larva after 12 to 14 hours.

Third instar larva (Fig. 9) : White to yellow in colour. Its length varied from 10 to 12 mm and its diameter varied from 1.5 to 2 mm. Segments 2 to 9 with complete anterior spine bands. Segment 11 with complete posterior spine band. Anterior spine bands of segment 10, 11 and 12 confined to ventral and lateral surfaces. Dorsal and ventral tubercles equal in length.

Cephalopharyngeal sclerite (Fig. 10) : Deeply pigmented. Hook part strong. Dental sclerite comma-shaped and prominent. Parastomal sclerite about the same length that of second instar. Dorsal cornu reduced and uniform in width. Sinus reduced. Window in ventral cornu reduced in size in comparison to second instar. Ventral cornu equal in length to dorsal cornu.

Spiracles : Anterior spiracles (Fig. 11) yellowish and each with 6 to 9 branches. Lobes are not arranged in a straight line but in a circle. Posterior spiracles (Fig. 12) heavily pigmented. It is twice in size than that of the second instar. Peritreme complete. Button present. Ventral arch short. Inner, dorsal and outer arch almost equal in length.

Third instar larva is transformed into pupal stage after 103 to 104 hours.

Puparium (Fig. 13) : Brown in colour. Its length varied from 6 to 7 mm and its diameter varied from 2 to 2.5 mm.

Pupal stage lasted for an average of 183–186 hours.

Total time required for completing the life history of this species from egg to adult is about 13 to 14 days.

Mature Stage (Figs. 14-20)

Diagnosis : Eyes holoptic; frontal vitta dark brown; upper part of parafacial black with silvery pollen; face yellowish brown; metacephalon blackish green with silvery pollen and numerous black

hairs; second antennal segment dark brown, third reddish to dark brown; thorax green to copper with white pollen; acrostichal bristles 2 + 2 and dorsocentral bristles 3 + 3; upper part of propleura and prosternum hairy; numerous black hairs present on suprascutular convexity; wings hyaline; R_1 bare and R_{4+5} with a row of short setae on dorsal and ventral surfaces; upper squama with yellowish white cilia and lower squama with light brown cilia : legs black; hind tibia with 2 anteroventral bristles; abdomen metallic green to copper with faint whitish pollen; third and fourth tergites with distinct marginal bands, second indigo-blue, purple to dark green, third and fourth with indigo to bluish bands on the posterior margin, fifth with long bristles entirely : first sternite with brownish hairs, second with numerous long hairs, third and fourth with numerous black hairs laterally, fifth sternite v-shaped with numerous long black hairs terminally (Fig. 14).

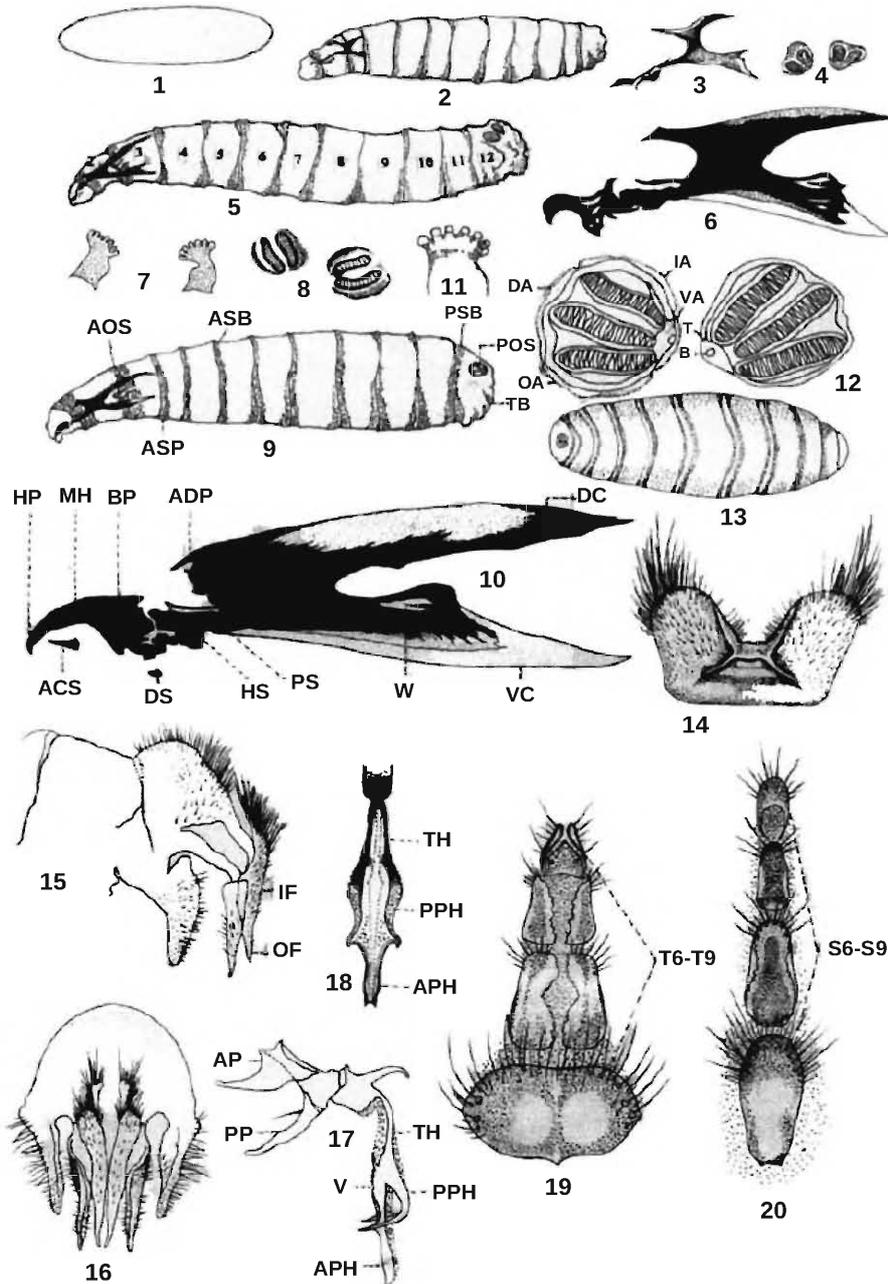
Male genitalia : First genital tergite metallic green, second dark green with grayish pollen and with a pair of brown lobes ventrally; inner forceps dark brown, slender and with diverge for a long distance, outer forceps brown and slender with pointed end (Figs. 15-16); anterior paramere wide at middle and pointed terminally, posterior paramere slender with one hair basally; paraphallus longer than acrophallus and acrophallus slightly blunt at end (Figs. 17-18).

Female ovipositor : First tergite of ovipositor wide and with numerous hairs terminally, sixth large, seventh and eighth elongated and inner margin of seventh tergite concave, ninth wide and shorter than seventh; cerci elongated with few hairs; seventh sternite shorter than sixth, ninth horse-shoe shaped (Figs. 19-20).

Distribution : Palaearctic region : China, Japan, and Korea; Oriental region : India (Assam, Bihar, Sikkim, Tamil Nadu, West Bengal), Indonesia (Java, Sumatra, Sulawesi), Malaysia, Nepal, Philippines, Sri Lanka, S. China, Taiwan and Thailand; Australian and Oceanian regions : Australia, Indonesia (Maluku, Irian Jaya), Japan (Bonin Islands), New Zealand and Papua New Guinea.

DISCUSSION

The larvae of this species are generally found in carcasses of animals, human and other animal faeces, garbage and other decaying materials and the larvae breed therein. The adult flies are mostly available in all seasons and their abundance in Sundarbans Biosphere Reserve is more in the months of November to February when the fishing and fish processing are done in coastal area. This fly breeds not only on *P. microdon* but also on other fishes. A large number of netted fish is processed and dried for future use during this time in different coastal areas of this Biosphere Reserve, which offer a potential breeding media of different fly species. The larvae of different dipteran species cause a substantial loss of dried fishes (Sinha and Nandi, 2003) in this area because the larvae breed in and feed on maximum fleshy portion of these fishes. No report has yet been available regarding the life history of this species and the percentage of loss caused by the larvae of this species on this and other coastal fishes, which are used in dry fish processing centers.



Figs. 1-20. : 1. Dorsal view of egg, 2. First instar larva, 3. Cephalopharyngeal sclerite of first instar larva, 4. Posterior spiracle of first instar larva, 5. Second instar larva, 6. Cephalopharyngeal sclerite of second instar larva, 7. Anterior spiracle of second instar larva, 8. Posterior spiracle of second instar larva, 9. Third instar larva, 10. Cephalopharyngeal sclerite of third instar larva, 11. Anterior spiracle of third instar larva, 12. Posterior spiracle of third instar larva, 13. Puparium (dorsal view), 14. Fifth sternite of male, 15. Inner and outer forceps (lateral view), 16. Inner and outer forceps (ventral view), 17. Penis (lateral view), 18. Penis (ventral view), 19. Ovipositor (dorsal view), 20. Ovipositor (ventral view).

The study of loss caused by the larvae of this species is still waiting for future observation. Association of this adult flies with different micro-pathogens is not known and it is expected that this fly might be a carrier of different micro-pathogens due to its filthy habit. So, there is a great scope to study the percentage of loss caused by the larvae of species on different dried fishes and the association of the adult flies with different micro-pathogens.

The present study shows some differences in larval structures given by Kano and Sato (1952) and Ishijima (1967). Dorsal cornu of cephapharyngeal sclerite of second instar larva is longer here and the ventral cornu of first instar larva much wider here.

SUMMARY

Life history of *Hemipyrellia ligurriens* (Wiedemann) on Bholu fish, *Panna microdon* (Bleeker) in laboratory conditions from India along with descriptions and figures of egg, three larval instars, puparium have been given. Mating was observed from the 4th–7th day after emergence of the adult flies from pupal case. This species deposited a total of 583 eggs in seven batches with highest number on 24th day after 12th day of emergence of the adult. First instar larval development period varied from 5–6 hours, second instar varied from 12–14 hours, third instar varied from 103-104 hours and pupal stage varied from 183-186 hours at $24 \pm 4^\circ\text{C}$ and relative humidity of $66 \pm 4\%$. The sex ratio of the emerged flies was 1 : 1. Longevity of male and female flies with food ranged from 33 and 51 days respectively and without food 4 days. Short diagnostic characters of the adult flies along with figures of male genitalia and female ovipositor have also been included. Distributional records of the species from India and rest of the world are also reported.

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Abbreviations used in the figures : ACS-Accessory sclerite, ADP-Anterodorsal process, AOS-Anterior spiracle, AP-Anterior paramere, APH-Acrophallus, ASB-Anterior spinose band, ASP-Anterior spiracular plate, B-Bitton, BP-Basal piece, DA-Dorsal arch, DC-Dorsal cornu, DS-Dental sclerite, HP-Hook part, HS-Hypostomal sclerite, IA-Inner arch, IF-Inner forceps, MH-Mouth hook, OA-Outer arch, OF-Outer forceps, PP-Posterior paramere, PPH-Paraphallus, POS-Posterior spiracle, PS-Parastomal sclerite, PSB-Posterior spinose band, S6–S9-Stermites 6th to 9th of female, T-Tail, TB-Tubercles, TH-Theca, T6–T9-Tergites 6th to 9th of female, V-Ventralia, VA-Ventral arch, VC-Ventral cornu, W-Window, 2-12- Body segments.

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